ROCKY MOUNTAIN COLLEGE

Course Syllabus: MAT 481 – Introduction to Real Analysis

Spring Semester 2013

Instructor: Ulrich Hoensch, Ph.D.

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- Office Hours: Monday, Wednesday 9:00 a.m. - 10:00 a.m. and 2:00 p.m. - 3:00 p.m; Tuesday, Thursday 9:00 a.m. - 10:00 a.m; Friday 9:00 a.m. - 10:00 a.m.; and other times by appointment.

Class Information

- Credits: 3 semester hours
- Class Meetings: by appointment
- Room: by appointment
- Class Web Page: `www.rocky.edu/~hoenschu/SS_2013/MAT481/main.html`

Text James S. Howland, *Basic Real Analysis*, First Edition (2010), Jones and Bartlett, ISBN 0-7637-7318-2.

Course Description An introduction to the field of real analysis, with emphasis on precise definitions and results related to the mathematical objects of calculus: the set of real numbers, sequences and series of real numbers, continuous functions, derivatives, and integrals. Results will be established in a mathematically rigorous manner, both in the lecture, and in student-supplied work. Prerequisites: MAT275 and MAT 212.

Rationale MAT 481 is a required class for a major in mathematics, and can be used as an upper-division elective class for the mathematics education major, and both the mathematics and mathematics education minor. It is a highly recommended course for students intending to enter graduate school, or a comparable professional program, in the areas of mathematics, engineering, and physics.

Course Objectives At the completion of MAT 481, students will be able to:

(1) Provide proofs of statements involving the properties of natural numbers and real numbers.

(2) Compute limits of sequences and prove statements about limits.

(3) Compute limits of functions, identify discontinuities of functions, and prove statements using the intermediate value theorem and the extreme value theorem.

(4) Compute derivatives, prove statements about derivatives, use the critical point theorem, the mean value theorem, and L'Hopital's rule.

(5) Use the definition of the Riemann integral and related results to determine the integrability of a function and the value of the integral.

(6) Determine whether a given series converges or diverges and find the value of a convergent series.

(7) Identify uniformly and non-uniformly convergent sequences of functions, and apply results related to uniform convergence.

(8) Find the domain, derivatives, and integral of power series and express known functions as power series.

Methods of Evaluation Students will be evaluated based on the following evidence.

- Homework assignments.
- Attendance record, timeliness, the amount of courtesy and respect extended towards fellow students and the instructor.
- Ability to independently and critically read the textbook, and apply the knowledge thus acquired.
- Level of academic and personal honesty and integrity.

Criteria for Grade Assignment To receive a passing grade, a student must show evidence that she/he is able to successfully perform the tasks laid out as course objectives (see above). Furthermore, students must attend all class meetings, arrive on time and exhibit appropriate classroom and social behavior. More specifically, a student is required to have accrued at least 60% of possible points to meet these criteria (see below). In addition, all submitted work must be the student's own work, or if it is not, names of sources or collaborators must be identified.

Possible points will come from: Homework assignments from the text, worth a total of 600 points. The following grading scale will be used to assign grades.

A: 90%, or more B: 80% - 89% C: 70%-79% D: 60%-69% F: less than 60% of possible points.

Instructional Methods and Experiences This is an independent study class. A minimum of one weekly meeting with the instructor is recommended. Study groups outside of class are encouraged. However, completion of homework assignments must be done independently by each student.

Class Policies Students are required to attend all class meetings and complete all assignments. All homework assignments must be submitted at the beginning of class on the due date. All in-class assignments, including tests, must be completed in the time allotted by the instructor. All work on tests and homework assignments must be the student's own work, and may only be obtained through the use of allowed tools. Tests may only be made up if the instructor is notified of qualified absences. Qualified absences are limited to the following: (A) activities connected with

Rocky Mountain College programs; (B) grave illness (in which case a doctor's note is required); (C) a family or personal emergency, or due to force majeure. In case (A), the instructor must be notified in advance of any absence. In cases (B) and (C) above, students may be excused from assignments if they notify the instructor immediately after their absence.

College Academic Policies Students must abide by all Academic Integrity Policies of the College. See `http://www.rocky.edu/index.php?type=academics&ct=policies` for details.

Schedule and Homework Assignments

Week	Assignments/Remarks
Jan 7 - Jan 11	Section 1.2 (The Integers and Mathematical Induction): 4,5,7 Section 1.3 (The Real Numbers): 3,4 Section 1.4 (The Axiom of Continuity): reading only
Mon Jan 14	**Week 1/Section 1.2-1.4 Homework Assignment Due**
Jan 14 - Jan 18	Section 1.5 (Supremum and Infimum): 1,2,3,6 Section 1.6 (The Archimedean Property): 3 Section 1.7 (Supplementary Problems): select any two
Tue Jan 22	**Week 2/Section 1.5-1.7 Homework Assignment Due**
Jan 22 - Jan 25	Section 2.1 (Sequences): 1,3 Section 2.2 (The Limit of a Sequence): 2,3 Section 2.3 (Properties of Limits): 2,4,5,7
Mon Jan 28	**Week 3/Section 2.1-2.3 Homework Assignment Due**
Jan 28 - Feb 01	Section 2.4 (Infinite Limits): 2,6,7 Section 2.5 (The Monotone Sequence Theorem): 1,2,5,6 Section 2.6 (The Bolzano-Weierstrass Theorem): 1,2
Mon Feb 04	**Week 4/Section 2.4-2.6 Homework Assignment Due**
Feb 04 - Feb 08	Section 2.7 (Cauchy Sequences): 2,3 Section 2.8 (Application to Infinite Series): reading only Section 2.9 (Limits Superior and Inferior): 1 Section 2.10 (Supplementary Problems): select any two
Mon Feb 11	**Week 5/Section 2.7-2.10 Homework Assignment Due**
Feb 11 - Feb 15	Section 3.1 (Limits of Functions): 1,3,5,6,7 Section 3.2 (Limits and Sequences): reading only Section 3.3 (Continuity): 1,4,5,6 Section 3.4 (Infinite Limits): 1,3,7,9
Mon Feb 18	**Week 6/Section 3.1-3.4 Homework Assignment Due**
Feb 18 - Feb 22	Section 3.5 (One-Sided Limits and Monotone Functions): 1,2 Section 3.6 (The Intermediate Value Theorem): 1,2,3,5,8 Section 3.7 (The Extreme Value Theorem): 1,3,5 Section 3.8 (Supplementary Problems): select any two
Mon Feb 25	**Week 7/Section 3.5-3.8 Homework Assignment Due**
Feb 25 - Mar 01	Section 4.1 (Derivatives): 2,3 Section 4.2 (Rules for Derivatives): 2,3 Section 4.3 (The Critical Point Theorem): 1 Section 4.4 (The Mean Value Theorem): 4,5,6,8 Section 4.5 (L'Hopital's Rule): 1,3,4 Section 4.6 (Supplementary Problems): select any two
Mon Mar 11	**Week 8/Section 4.1-4.6 Homework Assignment Due**
Mar 11 - Mar 15	Section 5.1 (The Riemann Integral): 1,3,5 Section 5.2 (Properties of the Integral): 1,2 Section 5.3 (Riemann's Integrability Condition): 2 Section 5.4 (Integrability Theorems): 1,2 Section 5.5 (Uniform Continuity): 1,2,4
Mon Mar 18	**Week 9/Section 5.1-5.5 Homework Assignment Due**

Week	Assignments/Remarks
Mar 18 - Mar 22	Section 5.6 (Integrability of Continuous Functions): 1 Section 5.7 (Riemann Sums): 2,4 Section 5.8 (The Fundamental Theorem): 1,2 Section 5.9 (Substitution and Integration by Parts): 1,2,8 Section 5.10 (Improper Integrals): 5(a)-(i), select any five Section 5.11 (Supplementary Problems): select any two
Mon Mar 25	**Week 10/Section 5.6-5.11 Homework Assignment Due**
Mar 25 - Mar 28	Section 6.1 (Convergence): reading only Section 6.2 (Series of Positive Terms): 2,3 Section 6.3 (The Ratio and Root Tests): 1 Section 6.4 (Absolute and Conditional Convergence): 1 Section 6.5 (Rearrangement of Series): 1
Tue Apr 02	**Week 11/Chapter 6 Homework Assignment Due**
Apr 02 - Apr 05	Section 7.1 (Limits of Sequences of Functions): reading only Section 7.2 (Uniform Convergence): 1,3 Section 7.3 (Continuity): 2,3,4
Mon Apr 08	**Week 12/Section 7.1-7.3 Homework Assignment Due**
Apr 08 - Apr 12	Section 7.4 (The Weierstrass M-Test): 1,3 Section 7.5 (Integration): 1,2 Section 7.6 (Differentiation): 1 Section 7.7 (Iterated Limits): 1,3,4
Mon Apr 15	**Week 13/Section 7.4-7.7 Homework Assignment Due**
Apr 15 - Apr 19	Section 8.1 (Power Series): 1,2,3 Section 8.2 (Operations on Power Series): 1,2 Section 8.3 (Taylor's Theorem): 2,4
Mon Apr 22	**Week 14/Section 8.1-8.3 Homework Assignment Due**

OPI/PEPPS Standards

Standard	Course Objective
10.58.518 Mathematics	
(1) The program requires that successful candidates:	
(b) reason, construct, and evaluate mathematical arguments and develop an appreciation for mathematical rigor and inquiry;	(1), (2), (3), (4)
(c) communicate mathematical thinking orally and in writing to peers, faculty, and others;	(1), (2), (3), (4)